Journal of the Society of Arts.

FRIDAY, MAY 27, 1859.

CONVERSAZIONE.

The Second Conversazione of this Session will be held to-morrow (Saturday) Evening, the 28th inst., at the South Kensington Museum. The doors will be opened at 8 o'clock.

The following divisions of the Museum will be open on this occasion:—

1. The Sheepshanks Gallery of Pictures.
2. The Sculpture Gallery.
3. The Architectural Museum.
4. The Animal Produce Collections.
5. The Ornamental Art Collections.
6. The Structure and Building Materials Collections.
7. The Educational Collections.
8. The Collection of Patented Inventions.
9. The Art Training Schools.

The band of the Coldstream Guards will be in attendance. Carriages are to set down at the refreshment entrance.

EXHIBITION OF INVENTIONS.

The Exhibition was opened on Monday, the 25th ult., and will remain open every day until further notice, from 10 a.m. to 4 p.m., and is free to members and their friends. Members by ticket, or by written order, bearing their signature, may admit any number of persons. Members of Institutions in Union with the Society are admitted on showing their cards of membership.

EXAMINATION PRIZE FUND, 1859.

The following are the Donations up to the present date:—

	£	s.
John Ball, Examiner in Book-keeping (2nd donation)	5	5
Harry Chester, Vice-Pres. (2nd donation)	5	0
C. Wentworth Dilke, Vice-Pres., Chairman of Council (4th donation)	10	10
T. Dixon	1	1
Frederick Edwards (annual)	1	1
J. G. Frith, Mem. of Council (2nd donation)	5	5
F. Seymour Haden (annual)	2	2
W. Haldimand	10	10
Edward Highton (annual)	2	2
James Holmes (annual)	1	1
Henry Johnson (2nd donation)	25	0
London Committee of the Oxford Middle Class Examinations	5	5
Charles Ratcliff (annual)	10	10
Dr. Skey	1	1
Rev. Dr. Temple	6	6
A Teacher	5	0
Matthew Uzielli	50	0
Rev. A. Wilson	2	2

PRIZE FOR AN ESSAY ON MARINE ALGÆ.

A Prize of £100 has been placed at the disposal of the Council, by Sir W. C. Trevelyan, Bart., to be awarded for "The best Essay on the Applications of the Marine Algæ and their products, as food or medicine for man and domestic animals, or for dyeing and other manufacturing purposes. Competitors must give the results of their original investigations on seaweeds; and they must prepare a series of specimens illustrative of the best modes of collecting, preserving, and preparing the several species. Mere compilations will not be admitted to competition."

The Essays, with accompanying specimens, must be sent to the Society of Arts by the 31st day of December, 1860. Each Essay to be marked "Essay on Marine Algæ," and to have a motto or distinctive mark attached, which mark must also be written on a sealed letter, containing the name and address of the author.

The letters containing the names and addresses of the authors will remain with the Society of Arts, and none will be opened except that bearing the motto or mark attached to the Essay to which the adjudicators award the Prize.

Copies of the conditions may be obtained on application to the Secretary of the Society of Arts.

TWENTY-FOURTH ORDINARY MEETING.

Wednesday, May 25, 1859.

The Twenty-Fourth Ordinary Meeting of the One Hundred and Fifth Session was held on Wednesday, the 25th inst., Professor Donaldson in the chair.

The following candidates were balloted for and duly elected members of the Society:—

Bendon, George	Jones, Charles Frederick
Charles, William	Norfolk, Horatio Edward
Davis, John	Piggot, Adolphus
Dennett, Charles, F.	Stedall, Robert
Dyott, John Philip	Tann, John
Hobler, Francis Helvetius	Young, W.

The Paper read was—

SOME REMARKS ON THE APPLICATION OF DEFINITE PROPORTIONS AND THE CONIC SECTIONS TO ARCHITECTURE, ILLUSTRATED CHIEFLY BY THE OBELISK, WITH SOME HISTORY OF THAT FEATURE OF ART.

By John Bell, Sculptor.

Few, I suppose, who have been in the habit of looking with interest upon features of architecture, but have noticed the apparent concavity of long perfectly straight and flat forms. One of the most common of these cases is to be found in manufacturing towns, or in any great factory, as the arsenal at Woolwich, where tall chimneys have been built with perfectly straight sides. In regarding these, an appearance of concavity arises, insomuch that those who are not aware of this delusion of the eye,

are apt to pronounce the sides actually concave. No precise point or points can, however, be specially indicated for this appearance of insufficiency, which seems rather to wander up and down these tall forms, eating by turns into every part of their outline. So painful is this insufficiency to the educated eye, that even in this strictly utilitarian feature, a slight swell has occasionally been given to obviate this unpleasant effect. Now the adding of a compensatory fullness to lines of this character was not an occasional thing with the Greeks, but was one of their constant architectural principles, as is well exemplified in their columns. It is true that formerly this fact was not sufficiently regarded; nevertheless actual and most precise measurements on the spot have fully proved that this curvilinear treatment of a compensatory nature was universally adopted in the best time of Athenian art.

It appears the more extraordinary that this compensatory treatment should ever have been lost sight of, inasmuch as Vitruvius has, in his well-known treatise on architecture, that text book of ancient art, which was written in the time of the Emperor Augustus, described explicitly this treatment both of upright and transverse lines in architecture, and registered it as a received principle in his time. Thus in Book 3, chap. 2, in speaking of columns, he says—"The eye is constantly seeking after beauty, and if we do not endeavour to gratify it by proper proportions and increase of size, when necessary, and thus remedy the defect of vision, a work will look clumsy and disagreeable." Of the swelling which is made in the middle of columns, which the Greeks call "ἔντασις, so that it may be pleasing and appropriate," he says, "I shall speak at the end of the book." But it is not only of this curvilinear treatment of the upward contours of columns that this ancient authority speaks, but also of applying analogous modifications of the straight line in a delicately arched form to the horizontal lines of buildings. In chap. 3 of the same book, he thus speaks of the line of the stylobata or the upper step on which the columns of a portico or of the front of a temple are placed. "This," he says, "should not be a straight line, but it should be very gently arched, as thus—"The stylobata should be so adjusted that it should be highest in the centre, for if it be set out level, it will have the appearance of being sunk in the centre." In this instance, as well as in the columns, this treatment was applied, to use his own expression "to remedy a defect in vision," or what rather we may prefer to call an optical delusion.

We may remark, *en passant*, that although the clothing of the column with the entasis has now become so received a practice with us that no workman would think of putting up one with perfectly straight sides, yet that few architects have as yet accepted into their practice the same principle of entasis in the long transverse lines of their buildings, although I fully feel with Vitruvius that in order to gift them with complete sufficiency, these also require a slight compensatory treatment. One more quotation from Vitruvius, to bear out that this treatment was also carried into the upper part of the structure. He thus continues, "The capitals, being completed, are to be set on the tops of the shafts, not however level throughout the range of columns, but so arranged with a guage as to follow the inclination which the small elevations in the stylobata produce." Thus a slightly curved line of upward entasis is produced in the range of the capitals or tops of the columns as well as at their bases. So far Vitruvius, and now we will turn for a short space to some results of the investigations which have been made of late years at Athens with respect to the lines of her ancient architecture, by Mr. Pennethorne, Mr. Cockerell, Mr. Donaldson, and Mr. Penrose; the elaborate work by the latter gentleman having now become the text-book on the subject.

Mr. Penrose resided for a considerable time in Athens, and was indefatigable in measuring by the most delicate and accurate means the remains of the Athenian edifices. In his investigation into the principles of Greek architecture, he says, "One of the principal objects of this work is the investigation of the various delicate curves which form the principal architectural lines of certain of the Greek buildings of the best period, which in ordinary architecture are, or are intended to be, straight."

I shall now proceed to lay before you some results of this gentleman's observations in as condensed a form as I am able. First, with respect to the column. For brevity I will confine myself to those of the Parthenon, although his work includes others with analogous results. The sides of these columns of the Parthenon are not straight lines, but are somewhat curved and convex, or, to use the express term, have an entasis on their sides. The term entasis is derived from the Greek verb ἐντείνειν, to stretch a line or bend a bow. Thus the greatest amount of bend has come to be called the arrow or "sagitta" of that bend, and thus when we speak of the amount of the entasis: we say an entasis of such and such a sagitta. Now, the "sagitta" of the entasis of the columns of the Parthenon, that is its greatest divergence from a straight line, is very slight, for it only amounts to $\frac{1}{552}$ part of the whole height of the shaft of the column. This, one might say, is so small that it could not be appreciated, but yet in practice it fully does its duty. The shafts of the columns of the Parthenon do not look hollow on the sides nor weak in their intermediate portions, which they would have done had their contours been perfectly straight. The compensatory curve, "to remedy the defect in vision," has, in this case, been so admirably adjusted as to offer a standard example, not to be surpassed, of this delicate architectural refinement. It naturally next occurred to Mr. Penrose to investigate what exact line of curve this was. He soon discovered it was not to be produced by a circle, however long the radius might be. It could not be a segment of any circle, for in that case the sagitta, or greatest amount of deflection from a straight line, would be at a point halfway up the column, which is not the case; the sagitta being rather between one-third and one-fourth up the column from the base, the curve of this entasis being, in this respect, like that of the flexure of a bow, of which the upper portion is stiffer than the lower. Of course you will keep all this distinct from the general tapering of these columns. All columns of this character taper, which is seen at first sight. What these remarks on entasis apply to, is that they do not taper in straight lines, but in curved ones; of which, although the agreeable result and effect is perceptible to all eyes, yet they are so delicate in their degree of bending, that their curvature is not recognised at first sight, except by an eye expressly educated to the fact. These curved lines of the Parthenaic columns, although they nearly approach to some portions of the conchoid of Nicomedes, and also of the catenary curve, have yet been pronounced by Mr. Penrose to be solely capable of being perfectly afforded but by one geometric line—that of one of the simple conic sections which is called the hyperbola. He thus pronounces the entasis of the columns of the Parthenon to be a portion of a hyperbolic line, of which the more bent part is at the base and the straighter portion towards the top of the shaft. Whether this line was, in fact, obtained by the Athenians from a strict conic section, or by a minute correction of the conchoid, adopted since by Vignola and set forth in Nicholson's method, or by some use of the catenary curve, is not necessary for us here to enter into. Mr. Penrose conducted his investigations on the spot at Athens with the utmost care, and I have no doubt we are ready to accept his acute evidence.

I will now turn to the application of the same principle of delicate curves to the horizontal or, more correctly speaking, the transverse lines of Greek architecture. **We have seen that Vitruvius said that these lines should rise somewhat towards the centre, or else they would appear to**

"sink in the centre," so that this transverse addition, or "entasis," is derived on the same principle as the entasis on the lateral lines of the column, viz., that it should be strictly compensatory. This slight rise towards the centre in a delicate curve Mr. Penrose found on all the principal Athenian structures, not only on the basement and stylobata, but also in the range of the capitals of the columns, and in that of the entablature. In these cases also he pronounces this curve not to be that of the segment of a circle, but that of another of the simple conic sections, the parabola. The line of the front of the Parthenon is rather more than 101 of our feet in length, and the rise in the centre is not more than between two and three inches. As the flanks of the Temple are longer, so in them is the rise somewhat more. These minute corrections are of course only compensatory, and are not obtrusive; nor does there appear any probability of their being accidental, for, fortunately, the Parthenon is built on a rock, and therefore it may be well presumed that these lines have not undergone alteration. Mr. Penrose pronounces these transverse lines to be portions of a parabola. Mr. Jopling has, however, thrown out the practical hint of applying to these transverse lines the catenary curve, which in execution would differ but little from this parabolic line, by a method which has the advantages of simplicity and ease of application. He suggests the arriving at this curve for the stylobata, by stretching a mason's line from end to end of the basement of the building, at such a tightness as would afford the desired degree of curve. He would then simply refer this upwards by measurement, so as to give the upward entasis; simply reversing the catenary curve thus obtained along the whole front of the building, for the upward entasis of the upper step. I am quite inclined also to believe with this gentleman that a portion of one-half of a curve of this nature might also afford a very pleasing contour for the lateral lines of a column, as well as for various other features of architecture. With respect to the whole setting out and structure of the Parthenon, Mr. Penrose holds that even in the body of the building this slight rise in the centre took place. In addition to these modifications also, Mr. Penrose holds that all the tops of the columns inclined somewhat inward towards the body of the temple. We have thus seen that both the upward and transverse lines of the Parthenon are curved with very delicate entases. Mr. Penrose naturally then sought for the same in the roof lines of the tympanum. He found these slightly curved in the Theseum, but not in the Parthenon, where they are straight.

I will not go further into the adjustments of smaller details, having only space for broad features. I am now about to compare the elevation of the obelisk with that of the front of a Greek temple. Although of very different proportions, the two general features possess similar elements—these are the lower and upper transverse lines, the sides, and the roof lines. The shaft of the obelisk answers to the colonnade and entablature, and the pyramidion to the tympanum. In this way we may accept in a general point of view that the front of the temple is a very wide, short, obelisk, and the obelisk a very tall temple. We have seen that the sides of the columns of the Parthenon taper and slope; so do the sides of the obelisk; and we have also seen that these columns do so, not with straight sides, but with sides of very delicate entasis. I conceive that an obelisk should also have a lateral entasis. The lines of the upper step and entablature of the Parthenon have a slight upward entasis; so also in effect should be the case with the analogous lines of the obelisk. I am still doubtful, however, as to the inclined or roof lines of the pyramidion whether to follow the Parthenon or the Theseum. I have tried both, but I think I prefer the straight lines of the Parthenon. I do not wish to push this similitude of the two subjects of art too far, but I think you will allow that they possess in degree the same general elements. I desire, however, now to say a few words on a different and perhaps somewhat novel mode of obtaining a somewhat similar effect of rise in the centre of transverse lines by a different method from that of the Athenians. That is by a convex entasis on *plan* instead of in elevation. I have adopted this mode of *Entasis* on *plan* in the treatment of the obelisk, and hence I naturally came to think of it more generally as applied to other subjects. I conceive that all perfectly plane surfaces, especially when bounded by angles, look somewhat concave. I conceived that the flat faces of my obelisk in its first stage did so, and yearned for this correction. I supplied this at first by a convex entasis, or coming out on plan derived from a segment of a circle, for which, however, eventually I substituted one derived from the flat side of an ellipse. All the faces of this obelisk have thus, in addition to the lateral entasis, an elliptical entasis on plan of very delicate sagitta all the way up. As therefore this treatment runs from the base of the shaft to the apex it adds a slight upward arch to the base of the pyramidion, and to all transverse lines which might be put in the way of inscription on the shaft. This entasis on plan has been acknowledged, and I think I may say is recognised, as an improvement to the obelisk. And the question naturally occurs, might not this treatment have its advantages in subjects of more extension? as it not only gives a certain fullness and fluency to the surfaces, but gifts all transverse lines above the eye with the compensation of delicate entasis, even while the beds of structure remain actually flat. It is chiefly when transverse lines are long, and subtend a large angle to the eye, that they most appear to droop in the centre. When, therefore, the front of a portico is far off, these transverse lines do not require so much compensation as when near. Entasis on plan meets this point, as when at a distance, and the line of vision is but little raised, the compensation thus supplied sinks to an almost inappreciable quantity, but as you approach the compensation increases. There appears to me a peculiar quality of welcome in the idea of these lines of architecture rising as you approach, and arching up as it were at last to let you enter. On the other hand, with the front flat on plan, and the transverse lines actually arched, as hitherto practised, they remain of course equally arched whether you are near or far. Of course, however, it would be requisite in execution to consider its effect in going out of a building. I would merely repeat that entasis on plan, while it leaves the beds of structure flat, which is convenient in building, affords the compensation of a delicate entasis increasing as you approach. The requirements of explaining my views in the smallest compass will, I hope, excuse any apparent advocacy of my method over the other. The best thing I can say to modify this is to add that I have used both methods conjoined in my trials on the obelisk, of which I shall speak presently. I merely desire to avail myself of this opportunity to broach the subject of entasis on plan, which, if it be thought worthy of being reduced to practise, might be supplied according as found most suitable to the various cases, either by the ellipse, the parabola, the conchoid, or a circle of very extended radius, or by the catenary stretching of the mason's line according to Mr. Jopling's method, or by other curves.

A Slight Historic Sketch of Obelisks.

Having now occupied some time in these remarks on the curvilinear treatment of surfaces, I will, if you please, before I begin to illustrate my own views as to their application to the obelisk, vary my paper by some account of the ancient history and existing examples of that remarkable unit of architecture.

In the primitive state of the world nothing was more ready as a record of an event than to set up a stone in the place in which it occurred. Thus, as the Bible in-

forms us, did Jacob set up in Bethel the stone which had been his pillow, in record of his dream and the promise made to him, and the vision on that spot. "And Jacob rose up early in the morning, and took the stone that had been his pillow and set it up for a pillar." Subsequently, it is supposed from this type, these consecrated stones were not unfrequently called baituloi, or beitile, from Bethel. There is also another word which occurs in the Hebrew of the Bible, "Matsebah," which is in some instances translated "pillar," and at others "image," when it is apt to be thought to indicate a human figure. It appears, however, rather to have been used to indicate a high stone or obelisk. Selden, in his "De Jure Gentium," says, "nor while the word 'Matsebah' is translated "statue" does it signify what statue ordinarily does, *i.e.*, the human figure." Spencer also agrees that it indicated a column or a huge stone, rather than a human figure. Sanchoniathon states that the Phœnicians, and afterwards the Egyptians, consecrated columns to those who benefited mankind, and to the elements. Clement of Alexandria, quoting an old author, says that the Delphic Apollo was originally a column, and on the old coins of Apollonia that deity is recognised by the representation of an obelisk little different from those of Egypt. The reverence for the sun indeed, one of the purest forms of early profane worship, seems to have been often connected with the erection of the obelisk, which, from its being pointed at the top and increasing at the base, bears the general form of a ray of light (coming towards us), of which, according to some old authors, the obelisk was intended to be expressly a representation. Mr. Bonomi considers that the image of gold set up by Nebuchadnezzar, on the plain of Dura, to have been by no means the statue of a man, but a gilt obelisk. It was at the commencement of the 3rd chapter of Daniel that the words occur, "Nebuchadnezzar the king made an image of gold. The height of it was three score cubits, and the breadth thereof six cubits. He set it up in the plain of Dura, in the province of Babylon." Thus, as regards the proportions of this image, the height was ten times that of the breadth, which it is evident is wholly inconsistent with any proportions of the human frame. On the other hand it agrees closely with those of the more graceful Egyptian obelisks, of which the whole height is usually about ten times that of the side of the base. Mr. Bonomi, therefore, appears to be well borne out in his view that this image of gold, set up by Nebuchadnezzar, was not a statue of a man, but, in fact, an obelisk, gilt. It may also suggest itself that the worshipping commanded by the king was in some sort connected with the worship of the sun, of which fire was the worshipped type, as it was also a "fiery furnace," to which those were condemned who would not fall down before this great "ray of light." This, of course, was the abuse of a fine feature of architecture, no unusual occurrence, as even the most beautiful temples of the ancients were raised, not unfrequently, to deities of the most atrocious character.

The obelisk of the most extraordinary proportions of which ancient writings give us any record, was that of Queen Semiramis—which is thus described by Diodorus Siculus:—"Semiramis likewise caused a great stone to be cut out of the mountains of Armenia 125 feet in length and five in breadth and thickness" (so that it was twenty-five times as long as it was broad and thick). "This," Diodorus continues, "she had conveyed to the river by the help of many yokes of oxen and asses, and there put it on board ship and brought it safe by water to Babylon, and set it up in the most remarkable highway of that city, as a wonderful spectacle to all beholders. From its shape it is called an obelisk (obelos in Greek, signifying a spit), and it is accounted one of the seven wonders of the world." If this account of its proportions be correct, I cannot conceive it could have been beautiful, although it certainly was a wonder. It must have been secured in its erect position, I suppose, by being sunk in a socket, which treatment is applied to the Egyptian obelisks, but solely to the degree of preventing their shifting on their bases. Obelisks appear to have been as widely adopted as they are a simple feature in architecture. Indeed, they seem a form which is the common heritage of man, closely suggested also by nature, as for instance, by the Needles in the Isle of Wight. As the pyramid is a kind of scarped mountain, so is an obelisk a splinter of rock fashioned on four sides, and from its monolithic nature, more lasting than even the pyramid itself. In Maurice's Indian Antiquities, a sacred stone of this character is described by Captain Hamilton as existing in the Temple of Juggernauth. In the British Museum there is an Assyrian example, truncated, from Nimroud, in black marble, used, by means of relievi, as a record of events. As a feature of Art, the growth of the obelisk is evidently after this fashion. It first appears as a rude solitary stone, set up on end, of a long form, like the pillar of Jacob at Bethel. Then, gradually as the arts advanced, these features were fashioned and inscribed so as to become what Strabo emphatically calls them, "Books of History," the legitimate use of the obelisk surface being for inscription. Their use as such enduring and dignified records appears by no means, however, to have been confined to Egypt, as Sanchoniathon expressly tells us they were erected in Phœnicia prior to their adoption in Egypt. Yet it appears that it was in the latter country that they were most developed, the granite on the banks of the Nile lending itself so aptly to this purpose. Having thus indicated the extreme antiquity of these features of art as symbols, and as records of great historic events, we will proceed to some consideration of the best examples of these which remain to us, and will turn first to those of Egypt, which were transported to Rome by the Cæsars, and which still, after the lapse of so many centuries, and under its total change of dynasty and religion, still exist among the most striking decorations of that great city.

The Egyptian Obelisks in Europe.

I will preface, however, what I have to say of the Egyptian obelisks in Rome, by a list of those contained in Europe. In the British Isles we have four, but they are all small. The largest is at Corfe Castle, and does not exceed 22 feet in height. There is one at Alnwick, the seat of the Duke of Northumberland, and two smaller ones, truncated, in the British Museum, of black basalt. In France there is one at Arles and another in Paris, which most of my audience have probably seen, where it forms the centre decoration of the Place de la Concorde. In Florence there are two, in Constantinople two, and in Rome twelve. Thus, altogether, there are in Europe erect, 22 of these features of Egyptian art, which have been transported from time to time, with great care and attention, from their native land. Those in Rome are, for the most part, important in size as well as number. Also they were the first removed from Egypt, the Emperors of Rome appearing to have had a perfect passion for Egyptian obelisks.

The largest obelisk now existing in the world, is that called the "Lateran," from its situation in front of the Lateran Basilica in Rome. This splendid obelisk, originally, as it appears, 105 feet high, in one block, was, in the first instance, erected at Thebes, in Upper Egypt, in the propylœum of the Temple of Ammon Ra. Pliny says, this took place during the reign of Rhamses, King of Egypt, during the Trojan war, *i.e.*, nearly 1200 B.C. But obelisk readers discover on it also the name of Thothmes III. or IV., the 5th King of the 18th dynasty, who is the same as the Mœris of the Greeks, so celebrated for the formation of the great lake which took his name. Ungarelli assigns to it an antiquity of 1740 years B.C., and it now stands in the Lateran at Rome, a sufficient proof of the lasting nature of these records, having lived, as Mr. Burgess remarks, through the ruin both of

Ancient Egypt and Ancient Rome. Pliny, who tells the tale of its being first set up in Thebes by the King of Egypt, thus narrates:—" When it was on the point of being elevated, the king, being apprehensive that the machinery employed might not prove strong enough for the weight, with the view of increasing the peril that might be entailed by due want of precaution on the part of the workmen, had his own son fastened to the summit, in order that the safety of the prince might, at the same time, ensure that of the mass of stone." This probably is but an old tale, yet it points to the value and importance which was attached to these monolithic monuments in old times, and the degree to which they were cherished. The same author further narrates, that "it was in admiration of this work that, when King Cambyses took the city by storm, and the conflagration had already reached the very foot of the obelisk, that he ordered the fire to be extinguished; he entertaining a respect for this stupendous work which he had not entertained for the city itself. After remaining for more than 2,000 years on its original site it was floated down the Nile by Constantine to Alexandria, that Emperor intending it to embellish his new city on the Bosphorus. His death however occurring before this was accomplished, his son Constantius preferred to have it conveyed to Rome. In a vessel provided with 300 oars he caused it to be brought to Ostia, and thence up the Tiber to the Vicus Alexandri, a small landing-place about three miles below Rome. From this place it was dragged slowly, on low-wheeled waggons, to the Circus Maximus, on the spina of which it was set up A.D. 357. Of the time when it fell from its base we have no record. In 1588 it was discovered lying interred to a depth of nearly twenty feet, and broken into three pieces. It was re-erected in its present site, near the Lateran Basilica, by the celebrated architect Fontana, at the orders of the energetic Pope Sextus V. On the wall is a sketch of it as restored and decorated at the top, in a manner, however, which anything but improves it, for I quite agree with the Rev. Mr. Burgess that whatever may be done in the way of basing these monoliths, the apices and pyramidions should never be tampered with, as it destroys their upwardness and mars the whole feature. The pedestal on which it stands is of red granite.

I have hitherto been quoting from Mr. Burgess. I now quote from M. Bonomi. In this gentleman's notes on obelisks, he says:—" Having the opportunity of mounting on the top of the pedestal (in the winter of 1838-9), I found, by taking the dimensions of the lower part in a horizontal line, that it measured 12 palms 6 onci on two sides, and on the two other sides 12 palms 10 onci;" the sides thus being dissimilar in breadth, as is the case with Cleopatra's needle and some other examples. When it was re-erected, from the necessity of cutting the base so as to make it secure, and in the joining of it, it having been broken into three pieces, it appears to have lost somewhat of its length. At present it measures, as it stands with its pedestal and cross, 145 feet from the ground. It is supposed to have weighed not far short of 450 tons. It is covered on all four sides with hieroglyphic characters, in which the various titles of the King (Thothmes) are recorded. Thus, he is spoken of as "Lord of the upper and lower regions, and pleasant in his kingdom as the sun in heaven," and other loyal expressions. The religious feeling also, however, of the Egyptians is evinced by this same King being represented at the top of the obelisk as kneeling before Ammon, and presenting him with two cups, while the god in return holds out to him the symbol of life. Over the god is written, in hieroglyphics, " The bestower of perfect life, fortitude, and all goodness, Ammon Ra, lord of thrones;" and on the same obelisk the god Horus is mentioned as "Horus resplendent, the distributor of dominions and guardian of the double watch, &c."

The next example of the Egyptian obelisk in Rome, in point of size, is that which now stands in the centre of the Piazza San Pietro, in front of St. Peter's. This is, according to Mr. Bonomi, 83 feet 2 inches in height. It was brought from Heliopolis, in Egypt, to ornament the circus afterwards called that of Nero. " The main interest however attached to this obelisk," Mr. Burgess says, " arises from its being the subject of the first experiments of setting up a fallen obelisk in modern times, and from its being in one unbroken mass, weighing 331 tons. During its erection, the Pope had given orders that no one should speak above a whisper, especially during the last moments of its attaining an upright position. It appears, however, that something was in fault, and the machinery was "chock and block" before it was quite up. The workmen could haul no more, and there it hung not yet erect. A well-known story goes that at this breathless 'crisis' an English sailor, in defiance of the order of the Pope, broke the silence with the words, "wet the ropes," which being done, they contracted just enough to set up the huge monolith erect in its place. Our tar, however, has a rival in this claim, as the Romans attribute this opportune but bold advice to one of their own country, a member of the Bresca family of San Remo. " There is" indeed, Mr. Burgess informs us, " an old picture in the Vatican, which represents the man in the act of being seized by the guard. He was taken before the Pope to be condemned, when, however, instead of confirming the threatened punishment, Sixtus told him to name his reward. To which the bold adviser replied by suggesting the privilege of supplying the palm branches to the Sistine chapel, and his descendants still claim the monopoly." This obelisk was thus re-erected in 1586. It was originally brought to Rome from Egypt, in the reign of Caligula, by whose orders probably also it was cut, as there are no characters on it, while the Egyptians, on the other hand, in their own works of this kind universally used them for inscription, as open books. With its base and ornaments, as it now stands in the front of St. Peter's, as a centre decoration of the piazza, it measures, from the ground to the apex, 127 feet 6 inches. It also serves as the gnomon of a monster dial, traced on the pavement by Pietro Maccarini. Besides these two noble examples of the obelisk in Rome, there is the Flaminan obelisk, in the Piazza del Popolo, a genuine Pharoanic example. The Campensis obelisk, on the Monte Citorio, which so charmed Wilkelman with the beauty of its hieroglyphics, and the Pamphilian obelisk, in the Piazza Navona, associated with a fountain. There are also the Trinità del Monte and Aurelian obelisks, and five others, none of which however are very large. I present a few sketches of some of the above mentioned. This list, however, falls far short of the number of obelisks mentioned in the catalogue compiled by Publius Victor, in the time of Valentinian and Valens, A.D. 364, as having been then erect in Rome. In this public record he mentions 48 obelisks. The places of some of the missing ones are suspected, but there are still more than 30 to be accounted for.

Of the two obelisks in Constantinople, one is of very broad proportions.

The well-known example in Paris is somewhat irregular in execution, being also slightly bent. Its height is 76 feet 6 inches. It is still a monolith, being unbroken. It was originally set up in Luxor, by Rhamses II. Its weight is not far short of 300 tons, and its mode of re-erection, in its present site, is recorded in diagrams on the base on which it stands. The Egyptians, however, according to Herodotus, moved a monolith temple 600 miles, which Mr. Burgess calculates as weighing not less than 5,000 tons, or about 18 times the weight of the Paris obelisk—but no record remains of how this was done.

EGYPTIAN OBELISKS IN EGYPT.

I will now just give a catalogue of those obelisks which

still remain in Egypt. The principal of these is that which still stands erect at Karnak. It is only second in height to that of the Lateran, being 93 feet 6in. from base to apex. It is an obelisk of the time of Thothmes I. Its proportions are slender, even too slender according to the impression of some. It has, however, stood now between 3,000 and 4,000 years, which is some proof of permanence. Contrasted with these proportions are those of Cleopatra's needle at Alexandria, which is an obelisk of the time of Thothmes III. This is 69 feet in height. Its proportions are much wider than those of Karnak. Perhaps these two well-known examples may be taken to represent the opposite limits between the massive and the taper of graceful proportions in obelisks. The proportions I have chosen for mine are between the two. Besides these, there are six other obelisks of large size erect in Egypt, more or less broken. Besides these, there are prostrate 12 more, all Pharoanaic; and in the quarries of Assuan, at the first cateract, there is one partly wrought. Egypt, however, has, as you have seen, been largely despoiled of her remarkable and enduring monoliths, and at one time there were grounds for fearing that she might be left almost without an example of this characteristic. We, in Britain, at least now have no excuse for extending this spoliation, as we have discovered that we have granite in this country which would yield, if required, even a larger monolith than that of the Lateran. Mr. Bonomi, speaking generally of obelisks, says, "These monuments of Egypt may be described as long quadrilateral stones, diminishing from the base upwards, till within about one-tenth of the whole height. The monolith obelisk of British granite, which I proposed as a memorial of the Great Exhibition, in connection with a Public Drinking Fountain, does not vary much from these proportions. The shaft was suggested to receive on it the many names of the various nations who contributed on the occasion of 1851. Colonel Hamilton, of the Guards, had a somewhat similar idea. If firmly based, there are no elements of decay in a monolith obelisk, and in regard to such a one as a memorial of the Exhibition of 1851, Mr. Robert Hunt suggested to me that if the New Zealander, with whose visit Lord Macaulay threatens us 3,000 years hence to see the ruins of St. Paul's, does really substantiate that prediction, he might well, as far as analogy teaches us of the duration of obelisks, thus find one relic at least of the present time still erect and unfaded.

The Obelisk of Definite Proportions and Entasis.

Up to this, with the exception of the suggestion of entasis on *plan*, what I have put before you has been greatly composed of the words of others, chiefly of those of the late Mr. Legrew, the Rev. Richard Burgess and Mr. Bonomi. I now, however, come to a portion of my theme in which I am unavoidably obliged to recount my own doings in regard to the addition of definite proportions and entasis to the obelisk. I do not set this forth as an isolated example, but merely as an illustration of a principle, as I have already shown. However, I shall not attempt on the present occasion to apply this to any further feature of architecture, but will confine myself to an account of how my obelisk came to be associated with definite proportions, and the curves of the conic sections, and this merely as an abstract question, though also I am obliged to go into some details.

My attention was called to the subject of obelisks some years ago, by my having selected this feature as the principal one in a design I made, at that time wholly privately for myself, for a memorial of the Great Exhibition of 1851. In consequence of this, and in looking at two or three other obelisks, especially those models of Egyptian obelisks presented to the British Museum by Mr. Bonomi, it appeared to me that what I described at the outset of the paper strongly attached to them, viz; that there was an apparent weakness and insufficiency in their form, and that their sides looked concave. I at first attempted to remedy this defect, by contracting the shaft at the top, by sloping the sides more, still however, keeping those sides straight. But this did not answer. The proportions of the obelisk were marred thereby, and the apparent concavity was but little, if at all, obviated. On this I determined to put in practice an idea which had been floating in my mind for some time; that was to add entasis to the sides, analogous to what the Greeks did to their columns. For this purpose I had a cast of my little obelisk split down the centre of the four sides, and opened out at the top somewhat more than the due proportion, so as to allow for rounding the sides upwardly a little, the divisions being filled up level with plaster. I then rounded the sides with a gradual but almost imperceptible entasis upwardly, until I had done away with the look of concavity. I did this with rasp and sand-paper until I had satisfied my eye, and I confess the result pleased me. This was the first step. When however I had done this, I conceived the surfaces to look somewhat concave horizontally on plan; and, that I might obviate this, I determined to make these slightly convex horizontally, by a segment of a circle bowing outward. For this line, however, eventually, I substituted a segment of the flat side of an ellipse, as more suitable for an obelisk, and for the purposes of inscription. I then curved the top transverse lines and surfaces of the pyramidion and so on, until not a straight line was left on obelisk on base. These were all however of very delicate entasis, only compensatory, and in execution, from the scale and material of my model necessarily incomplete. About this time I had taken the opportunity of setting forth somewhat prominently a proposal that the principal feature of the memorial of the Exhibition of 1851 should be a polished monolith obelisk, of British granite, with all the names of the countries that contributed inscribed on it, combined with a public drinking fountain, to be placed in the centre of the site of the Exhibition in Hyde-park, suggesting in this case the introduction on the obelisk of entasis. In consequence of this, I was invited by the Royal Institute of British Architects to lay my views before them of the principle of the entasis applied to the obelisk. This I had the honour of doing in May last, now just a year ago. At the commencement of that evening a most interesting paper was read by the Rev. Mr. Burgess, "On the Egyptian Obelisks in Rome, and Monoliths as Ornaments in Great Cities," in which he recommended their adoption here. This introduced my paper, from which, if you please, I will read two or three extracts. I said "that it had for some time occurred to me that had the Greeks adopted the obelisk, as they did various other component parts of architecture from the Egyptians, as it is said, that there was a probability that they would have modified it in some degree, as they had done in regard to columns for instance." I added, "that I believed I was correct in saying that in whatever the Greeks adopted from other nations they made modifications, making it thus, as it were, their own, and that in passing through their hands the rough-hewn ideas of their neighbours became, not unfrequently, refined to a degree of perfection which later times have been able to do little more than repeat. If, then, the Greeks had adopted the obelisk, I suggested, would they have left it as they received it from the Egyptians? I fancy not."

I went on to remark that "the tomb of Beni Hassan, in Egypt, presented pillars which, on account of the remarkable similarity between them and those of the Greek Doric order, had received the name of "Proto-doric." These Egyptian pillars, however, are destitute of entasis, which the Greek Doric examples possess on scientific principles. In some, however, of the other examples of Egyptian columns the shafts contract boldly also at the base, but still I said I believed that there was nothing like a scientific compensatory entasis analogous to the Greek in principle to be found in any of these cases. I expressed then my desire, feeling that I was then,

in addressing the Institute, before the best architectural authorities, "to be corrected if I was in error in my supposition that thus the scientific compensatory application of the entasis to architecture generally, so as to satisfy the eye thoroughly, was reserved for the Greeks to arrange on just principles and to carry out with exactitude and beauty." I then went on to detail the making of my sketch model, which I have already narrated, and how in it the mission of entasis did not appear to end while a single straight line remained on the obelisk, nor the eye to be satisfied until every portion was clothed with these delicate curves, and in this respect I remarked on the yearning which a straight-sided obelisk appears to always express for these compensatory adjustments. Desiring also to test before such authorities whether I had been anticipated in my views and experiments, I invited information on that point. In the discussion which followed, Mr. Bonomi said, that when Mr. Angell and himself were in Rome together, that Mr. Angell had suggested the erection of scaffolding to measure the obelisks, with a view to ascertain if they had any entasis. But this idea was not carried out. Mr. Tite however, expressly stated that the straight sides of the Egyptian obelisks in Rome appeared to him to possess the insufficiency known to attach to perfectly straight treatment. Mr. Bonomi and Mr. Poole, both residents for a considerable time in Egypt, tell me that they have never detected any entasis on the examples in that country; nor does Sir Gardner Wilkinson, nor any other authority, as far as I know, allude to it. The tracings which I have here of some of the finest obelisks in Egypt are from careful figures in the great French work on Egypt, of the time of Napoleon I., and no trace of entasis is discoverable on them. Also if, as has been supposed, these features of art were in early times symbols of the rays of the sun, this does not favour the idea of any entasis having been applied to them, as assuredly a ray of the sun has no entasis.

Evolution of Definite Proportions in the Obelisk.

As regards my own attempt at a solution of this problem of applying curvilinear treatment to the obelisk, I have now brought you up to my progress in May last, when, as I informed the Institute of British Architects, I had only made a little sketch on the principles I spoke of without going into the refinements of detail for which the scale of this was not adapted. Circumstances, however, have since called on me to make a larger model not far short of 20 feet high, which has afforded me the opportunity of carrying the whole problem considerably beyond the point at which it then rested.

In my first little model I had adjusted its proportions and lines solely by my eye, and executed them actually by what in homely phrase is called the "rule of thumb." Now, however, that I had to have an enlarged and completed one executed by workmen, I had, of course, to furnish them with definite proportions to work by. I went to work therefore, for the first time, with my compasses, to seek out in my little model what definite proportions it really contained. I must premise that I had previously told my assistants that I thought the pyramidion a hair's-breadth too short. I added this slight increase in the working drawing, which is here. But it is so very small a correction as to be quite unappreciable, except on close inspection; and in an obelisk of a hundred feet it would not be above an inch. This is the sole variation between the original little model and the working drawing, which, however, I have preferred to place before you, as it is more easy to measure on, and as it shows the ground plan of each member. But to my process. I thus for the first time began to measure my little model to find out what definite proportions it possessed, when the following coincidences came out, one after another, quite unexpectedly, between what I had done merely by the eye and a consistent code of definite geometric proportions. In the first place I found, with my compasses, that the diagonal of the base of the pyramidion was exactly equal to the side of the base of the obelisk. This was the first step, viz., that the diagonal of the base of the pyramidion was equal to the side of the base of the obelisk. In searching further I found also that this gave the exact vertical height of the pyramidion itself. So here was a treble coincidence, of the most simple and definite nature. Firstly, that the diagonal of the base of the pyramidion. Secondly, that the side of the base of the obelisk; and Thirdly, that the vertical height of the pyramidion, should be all one and the same measure. Encouraged by this, I hoped that on applying this fortunate unit of measurement to the whole height of the obelisk, that I might be so favoured again as to find that it formed some aliquot part of this. But, no, it would not fit any way, either to the lateral or vertical measurement of shaft or whole obelisk. The measurement broke down altogether, and I was at fault. Having, however, found already that the diagonal of the pyramidion gave the side of the base of the obelisk, it soon occurred to me to try the diagonal of that base (that of the obelisk itself), which though growing out of the other, was a new measurement; and, having taken this, I began with my compasses walking up the vertical height of my obelisk, 1, 2, 3, 4, 5, 6, 7, when, to my surprise, and, perhaps you will smile when I add, to my great satisfaction, I found that I had landed with the seventh stride of the diagonal of the base exactly at the apex! Thus, seven times the diagonal of the base of the obelisk was the exact measurement of the vertical height of the obelisk. So here were all the general proportions of my obelisk exactly defined by one simple code of exact geometric proportions, of which the pyramidion was the key and pivot, and this arose quite unexpectedly out of a little obelisk which had been adjusted solely by the eye. More than one of those who assist me in my studio are here to-night, who witnessed the progress of my obelisk. They know I have not, in the least, "cooked my account." I dare say no one will suspect me of not being quite open, but it is pleasant to have proof at hand if required. The original little model also is in my studio at Kensington, and I shall be most happy to show it there to anyone who may take interest in the problem. As regards the number 7, as it is an element of so many things of great import, and characterised, as it is, as "the perfect number," I own it was a satisfaction that it should be that one which came in of itself to complete the code of definite proportions. In the Parthenon, the proportions have been stated by Mr. Penrose to all bear relation one to another, and to be composed of mutual aliquot parts, and Mr. Jopling has carried this still further. He has published a measure which he calls the pivot, and which is the difference between the diameters of the top and base of the shaft of one of the columns of the Parthenon, and which is also derived geometrically from the inscribed square of the top of the shaft. Seventy-two of these measurements give the breadth of the Parthenon, and 162 its length, and 10 of the same measurements the space between centre and centre of the columns. In like manner all the proportions of my obelisk possess a direct geometric relation. Taking a base of a cone of which the vertical height is equal to its diameter, the inscribed square is the base of the pyramidion, and the circumscribed square the base of the obelisk, and so on. An agreeable presentation arises from this, for you have only to strip a cone of this proportion, (viz., one of which the vertical height is equal to the diameter), from the apex down to the incribed square at the base, when you discover a pyramidion of the exact proportions of that of the obelisk, which is in turn the key to all the other proportions of the obelisk.

Application of the Conic Sections, as Entases, to the Obelisk.

This application of the cone to the pyramidion will serve to introduce the second portion of my treatment of

the obelisk, that of applying the conic sections to clothe it with its various entases. You know the simple conic sections are of five different characters. Firstly, there is the rectilinear one through the apex, of which a side of the pyramidion is an example. Secondly, the circular, cutting the cone in a plane at right angles with the axis. Thirdly, the ellipse, cutting the cone across, but not at a right angle, but slanting as it were. Fourthly, the parabola, which is a section parallel to the side of the cone, and which would never cut the cone, however much produced; and fifthly, the hyperbola, which, from its direction further approaching that of the axis still wider, avoids cutting the cone across. Lines derived from each and all of these qualities of section come in to complete the obelisk and base, and to endue with a compensatory fulness the cone produced by the definite proportions. I will not go now into the details of the mode of obtaining the hyperbolic line, which I adopted to give the lateral entasis of my obelisk, as it would occupy too much time. I would only say that my assistant on this occasion considered it should be struck from a point on a level with the base of the obelisk. I thought this would give too much entasis, as it proved eventually, and I therefore desired him to strike the entasis from a point on a level with two diagonals of the base below the base, as in the case of the columns of the Parthenon, when another very curious and unexpected coincidence came out, viz., that I had, without knowing it, and only to please my eye, made the base on which I had placed my obelisk exactly these two diagonals in depth. So that the entasis was eventually struck from the ground line of the basement, as is the case with that of the Parthenon columns. There appears a principle in this, and the entasis thus obtained for the obelisk (by Vignola's method with a minute correction) came out quite satisfactory, being just compensatory and no more. The sagitta of this curve is little more than an inch on the elevation in an obelisk of 77 feet 9 inches in height, being however of course somewhat more on the angle. This entasis is less than the entasis on the columns of the Parthenon, but somewhat more than that on those of the Erectheum. The elliptical entasis on plan, which I adopted for the surfaces of the obelisk has a sagitta of one-third of this. This entasis on the horizontal plane runs over the top of the shaft, and only vanishes at the apex. Thus all the eight surfaces are curved with lines derived from conic sections. The same treatment, in conjunction with lines derived from the parabola, is also applied to the bases which support the obelisk; and lastly, the circle, as the base of the cone in the lower compartment of these, in conjunction with the square, forms in its one circumference the four basins of the Drinking Fountain. Thus the solution of this problem has been guided throughout by the conjoined working of all the five simple conic sections, together with the perfect number 7 and a code of definite geometric proportions, of which each bears a direct relation to every other.

Conclusion.

I will not go further into the minor details of this obelisk, although there are several other results of the same character which have evolved themselves naturally from its code. I would desire, however, to say that I should be very sorry to be thought to presume that the code I have adopted for my obelisk is the sole one to be applied to that feature of art. I am very far from thinking this, although, perhaps, I may conceive that some general points of value may be indicated by the adventures of my solution. Even, also, in regard to the conic sections, although I may myself think that these marvellous curves which regulate the paths of the heavenly bodies are also those which chiefly form the curves of the leaf, the petals of the flower, and the graceful contours of female form, yet I am delighted to acknowledge the charm of other natural curves as the conchoid, the cardioid, and the catenary, &c., as applicable to art. The view, indeed, which I take of the obelisk is that it is a feature of art yet undeveloped, and one which, as far as I can discover, is in the same state in which it was left by the Pharoahs. Also, that it is a feature highly suited to monumental record; and, therefore, from these two causes, offering a fine fresh field for invention, both in regard to general proportion and minor details. My own I have introduced as a humble illustration of the working together of the eye in accordance with geometric proportions. The illustration may be inadequate, but the general principle, few in these days, I conceive, will be found to ignore, viz., that Science and Art should work together. The Greeks have amply proved their adherence to this maxim, which I offer as the moral of my remarks to-night. I wish, however, to be understood that I by no means fancy that a work of art is to be built up by the Rule of Three. To hold that, would, in my idea, be pedantry. We have been endowed with direct perceptions of beauty, which we should be absurd to lay aside to take up, instead, logarithms or algebra, but as in some sort geometry is the essence of reason, so, rightly applied, it comes in, I believe, to give definition and satisfaction to all forms of art. "Nature" has been said "to work by geometry," and the more art can do the same without crippling her more direct and intuitive methods, the better, I fancy, will be the result. In the achievement of forms of beauty, therefore, I hold that the concurrence of definite geometric proportions may be of the greatest practical use in aiding the eye when once you are so fortunate as to discover that ratio of their code which is in harmony with the subject in hand. Then, also, you have something explicit for your assistants to transfer and work by, and science and art advance hand-in-hand to the result. In undertakings of this kind, the square and circle, mutually inscribed and circumscribed, appear to afford a code of great value, not only as applied to the Parthenon, as shown by Mr. Jopling, and to the obelisk, but also to the proportions of the human frame, as I hope, at some future time, to have the honour of laying before you.

In the progress of the special problem of the obelisk, which I have had the honour to-night of submitting to you as an illustration, I have only now the pleasant duty remaining of returning my best acknowledgments to many who have taken an interest in it. Especially, I desire to acknowledge the liberality of feeling extended to me by the architectural profession. Being a sculptor, and not an architect, and this specially an architectural question, not only have I had no check on that account, but I have received, on the contrary, nothing but assistance and encouragement from that profession. Mr. Angell, Mr. Bellamy, Mr. Bonomi, Mr. Tite, Mr. Donaldson and others, have given me especial encouragement, and I have had much assistance from the labours of Mr. Penrose, at Athens. I have however especially to acknowledge the direct assistance of Mr. Jopling, a gentleman who is well known as having made definite proportions and scientific curves his especial study. Although certainly the idea and scheme of my obelisk is my own, yet in evolving it the knowledge and suggestions of Mr. Jopling have been of the most direct practical assistance. Perhaps also, in conclusion, the best excuse that I, as a sculptor, can offer for my having taken up this subject at all, is to be found in a remark made by that gentleman (himself an architect) one day in my studio, when he said to me, "You sculptors have your minds and eyes so constantly directed to form that your training is especially adapted to educate your perception of proportions and curves."

DISCUSSION.

The Secretary read the following letter from Mr. Joseph Jopling, who says:—

As I cannot be present at the Society of Arts when Mr. Bell's paper is to be read, I have enclosed my "Key

to Proportions of the Parthenon," and with this I send a copy of a letter to Mr. Tite,* on the arrangements of the surrounding columns of the "Mausoleum of Mausolus." For this I have received Mr. Tite's thanks.

During the last fortnight I have had some assistance at the British Museum, and have verified, from the remains of the Parthenon there, some most important facts.

I need only mention the exact height of the capital, viz., 2·8177 feet English.

This is exactly $\frac{1}{36}$ of Mason's line end upper step.

Ditto $\frac{1}{81}$ of Mason's line side upper step.

The number 36 is the number of divisions of 10° each in a circle.

$\sqrt{81} = 9 =$ number of divisions of 10° each in a quadrant.

$\sqrt{36} = 6 =$ number of divisions of a circle by radius.

I may just add that while calculations are necessary to prove the great accuracy of the Greek work and of Mr. Penrose's measurements, no measurements or calculations, so to speak, are required to design and set off work full size, on precise principles.

True results are obtained from principles with much less trouble, and with far greater accuracy, than by setting off any measurement from the most careful drawings, and with the most correctly divided scales, rollers, and rods.

This can be made manifest by setting out and drawing, full size, the plan of the column of the Parthenon, say of the east end upper step, with one or two return columns, and showing the direction of the inclination of the axis of each.

This, and very much more, can be done to illustrate the laws followed by the Greeks, without interfering with any object in that gallery of their antiquities.

At first this may be shown temporarily, to make manifest the facts. After complete conviction, no doubt a more permanent record of such laws will be deemed necessary to arrange every department of art, to study and make application of principles on principles—eternal laws of forms and proportions.

Mr. J. SCOTT RUSSELL, F.R.S., on being called upon by the Chairman, said he was sure they must all agree with him in hoping that the obelisk proposed by Mr. Bell as a memorial of the Exhibition of 1851, would be erected of a durable material, and on the proper site, so that they might judge upon a large scale of the effect of the realisation of Mr. Bell's proposition. He thought Mr. Bell had thrown out some valuable observations of a general nature in reference to architecture, which showed that architects and sculptors were beginning to unite and take broader views of their art. It was very satisfactory to see that two points, definite geometric proportions, and entases of delicate curves, which had been fancied to be only crotchets, suitable to the brains of an enthusiast, had been practically reconciled by being brought to the test of artistic feeling and scientific experiment. He thought it was a most important fact that Mr. Bell had felt his way to the production of such a form in this feature of art as should be perfectly pleasing to the eye, before he arrived at his theory, and that he derived this geometric theory of proportion from the actual model he had previously made. With regard to the particular proportions which Mr. Bell had found to rule in his obelisk, he (Mr. Russell) was very much pleased that they did so; for he had a notion that they ruled many other things besides. It was now proved that an object of true proportions could be appreciated by the artistic eye alone, unassisted by mathematical reasoning, and the perfect reconciliation of the two was the true basis of art; and was the basis from which he could not but hope we might cease to *imitate* in art, and begin to *create*. Now it simply came to this, when one was making choice of proportions in which considerations of utility did not enter, one was left to choose proportions which had nothing to control them but either pure reason, or, he would call it, pure instinct. Now this was quite certain, that in almost everything in which there was a choice, it was more pleasing to the mind to choose definite and exact proportions than to take indefinite and chance proportions. There was no

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* (COPY OF LETTER REFERRED TO.)

6, Vassall-terrace, Kensington, W., 25th Nov., 1858.

DEAR SIR,—Your most able paper on "The History, Discovery, and Remains of the Mausoleum at Halicarnassus," has directed my attention to figures and statements, to try if I could discover any law by which that monument may have been proportioned.

Without now explaining how, it may be sufficient at present to state that I have ascertained that with no more knowledge than—

3ft. 5in. as a diameter, and
7ft. 4in. as the space between columns,

or, 10ft. 9in. from centre to centre of columns,

the 36 columns of that mausoleum could not be arranged, on the surrounding plinth, of the dimensions 114 by 92, to appear as harmonious, on all sides, as the 46 columns in the Parthenon have been executed.

By what standard measure, or whether the dimensions of the mausoleum have been taken and recorded as accurately as those of the Parthenon by Mr. Penrose, is not stated.

The English foot is but a little less than the larger Greek foot and with less accuracy in the measure and the measurements than were used and made by Mr. Penrose, the results, as if measured by the true Greek foot, may have been gained, and thus account for the identity I am about to explain.

Previously to doing so, I beg to state that before the columns could be properly and harmoniously arranged, it was necessary that the distance from the edge of the plinth to the line of the centres of all the columns should be determined.

This distance I have found to be 2ft. 3in.

Then the measure 10ft. 9in., as stated, being made the distance from the centres of the rough columns to the centres of the second column, each way, allows exactly 11 feet for the distance from centre to centre of all the other columns, on all faces, thus :—

FOR A LONGER FACE.

ft.	in.		ft.	in.
2	3 by 2	... ...	4	6
10	9 by 2	... ...	21	6
11	0 by 8	... ...	88	0
		The length of the plinth given ...=	114	0

THEN, FOR A SHORTER FACE.

ft.	in.		ft.	in.
2	3 by 2	... ...	4	6
10	9 by 2	... .	21	6
11	0 by 6	... ...	66	0
		The other measure given of plinth	92	0

Is this not extraordinary accuracy?

But I have also found out the law, the process, by which the exact diameter stated was detetermined, and, I doubt not, the key to other proportions.

"Diameters" are not the first step, but results of a previous geometrical process.

Further, there is evidence that the proportions 3, 4, and 5, for setting off a right angle, were known to the architects of the mausoleum of Mausolus as well as of the Parthenon.

Again, in those marbles there is evidence of the knowledge of results of eternal laws applied in forms as well as in proportions; which, by systematic study, may be worked out and made as evident as the facts I have stated.

Surely further investigation into the precise principles of proportions and forms applied in the finest works of antiquity cannot be unworthy of the attention of a great nation, after so much time, labour, and cost, in procuring such objects of art.

I have the honour to be, dear Sir,
Your most obedient humble servant,
JOSEPH JOPLING.

William Tite, Esq., M.P.

The data for this letter were taken from the *Builder*. "Papers respecting the Excavations at Badium, presented to both Houses of Parliament by command of Her Majesty," I purchased 16th April, 1859, I now find contain further evidence of importance.

doubt whatever that the appreciation of exact and beautiful forms did increase and grow in one's mind by the knowledge of definite proportions. He thought the mind never perceived anything which it did not look for, but when to a work of art was brought a knowledge of definite proportions, then true appreciation followed, and it became possible to ascertain whether the artist knew more than the observer, or less. With the proportions clearly in the mind of the observer, he was able to discover them in a work of art, and without this he would not find them. He, therefore, said that a knowledge of definite, exact and reasonable form —form regulated by intelligible law, which could be carried in the mind—that was what the mind ought to bring to the judgment of Art, as well as to the creation of it. He was now about to make an observation, which he would guard them against misunderstanding. He was going to put, in rather an exaggerated form of words, what he thought was a very remarkable point involved in Mr. Bell's theory, and one well worthy of consideration. It was this—that the ordinary laws of perspective, as laid down in *the books*, were not the true laws of vision; the lines of perspective were in fact not straight lines; but he was prepared to show, by the most irresistible evidence, that they were slightly curvilinear. If a very large picture of a very large object were to be drawn, the straight line of perspective must be abandoned altogether. A very large object could not be represented in proper perspective to a human being of limited powers of vision by straight lines; for this reason—supposing one was in a long gallery, if one looked to one end of the gallery, the lines converged one way, and if one looked to the other end the lines converged in the opposite direction, and yet it was clear that these lines nowhere formed an angle with each other. What was the effect of that? Evidently that the lines were curved. Now the question was what kind of curve was this? It was simply the curve of the entasis, approximating infinitely near to a catenary or to a very flat hyperbola. He could not definitely say whether it was one or the other, but it was nearer to these curves than to the old-fashioned straight line. If this were true, the laws of actual vision were different from the laws of plane perspective; and then what Mr. Bell had said, necessary followed, because everything must be represented with this curve of entasis in order to appear to be in true perspective. He had never found this theory in any of the books, and he had ascertained from personal observation that the received laws of plane perspective were in this respect quite wrong. This law must, however, be taken with certain limits. What were these limits? They were, that practically, if one looked at a small portion of a side of a room, one did not require in the drawing of it any entasis, and if one went to a long distance, entasis was equally unnecessary; but if the object was a building, which was large in proportion to the human figure, and so near that the eye could not embrace it all, then entasis was necessary. Moreover, if this law of perspective was true, it would show that the entasis of columns, to be pleasing, must take its origin from the level of the eye. Therefore, talking of the entasis beginning at a point one-third up the column would be incorrect; and he had observed that if the plane from which the entasis of a column began was discovered, and the eye placed on a level with it, from that point the effect was perfect; but if the eye was not on a level with that point, the true effect of the entasis was lost. Therefore, the beauty of his friend Mr. Bell's obelisk was very much owing to the fact that the entasis began pretty near to the level of the eye. He doubted very much whether it would look as well if one looked down upon the obelisk from above.

Mr. BELL—When looked at from above it appeared exaggerated.

Mr. SCOTT RUSSELL—That was exactly what he should have expected; therefore he said the entasis, to be perfect, must spring as nearly as possible from the level of the eye. He would conclude his remarks by expressing a sincere hope that Mr. Bell would pursue his inquiries in this direction, and at a future time favour the Society with another paper upon this very interesting subject.

Mr. VARLEY remarked that the general principle of entasis had been very beautifully explained by Mr. Bell, who was an able and practical artist, and it was of universal application in architecture, but he must be allowed to express dissent from some of the remarks of Mr. Scott Russell, because he had left out of calculation one very important element. When they represented a building upon a flat surface, whatever way they looked at it they looked upon the same surface, and if there was entasis upon the building, it would be upon the paper. In his opinion the received laws were strictly true. There had, however, been a good deal of difference of opinion amongst artists upon this point. The application of definite proportions in this instance had very much delighted him. Mr. Bell had happily found his own artistic eye in harmony with geometrical rules; and he (Mr. Varley) attributed the rapid rise of the ancient Greeks to so high a degree of perfection in Art, to the fact that they acknowledged mathematics and geometry to be their masters, and they obeyed them.

Mr. SCOTT RUSSELL said he had distinctly stated that unless he guarded his expression with regard to perspective, he should be misunderstood. He meant to say that in a very limited scale, where the object could not be truly represented by a small piece of paper, the ordinary rules of perspective would be right; but when the eye embraced a view of (say) 180 degrees, they would see that all correct representation upon a flat surface, by the ordinary rues of perspective, ceased.

The CHAIRMAN said they were favoured with the presence of a gentleman whose name had frequently occurred in the paper as having rendered great service in the measurement and other details of monumental antiquity. He referred to Mr. Angell, who, he hoped would favour the meeting with some observations upon a subject with which he was so well acquainted.

Mr. ANGELL would merely remark that it was now upwards of a quarter of a century since he had had the advantage of examining the obelisks at Rome. His impression at that time was that there were no entases, and he had fancied, until he proved his mistake, that the ancients had made them concave on purpose; but he found them to consist of perfectly plane surfaces. The idea of introducing entasis on *plan* was very suggestive; and he was not certain whether it would not apply to exteriors for convexity, and to interiors for concavity. He was not prepared to advance anything upon that subject at present, but he thought it was one worthy of attention.

Mr. BELLAMY agreed with Mr. Bell that the artistic treatment of the obelisk had remained very much where the Pharaohs had left it, and that branch of art was in a very unsatisfactory state. In his own mind there was no question as to the value of entasis in the obelisk. Mr. Bell, in speaking of the various obelisks now in Europe, had omitted to mention the one at Ramsgate, erected in commemoration of the embarkation from that place of George the Fourth, upon a visit to his Hanoverian dominions. He had inspected that obelisk, and he had only to look at it for a moment to find that the sides, although perfect planes, presented an appearance of concavity which was unpleasant to the eye. If his mind had not been made up before, that inspection would have been conclusive to him. With respect to the entasis on plan in the obelisk, he thought Mr. Bell was perfectly right, but in his (Mr. Bellamy's) opinion, its application should be limited to small objects, such as the obelisk. For these it was invaluable, as it tended to correct the harshness which straight lines were sure to impart. Therefore as regarded the base, sides,

and pyramidion of an obelisk, he thought that for assigning them that delicate sectional curvature, Mr. Bell was entitled to the thanks of the architectural profession. The Greeks assigned to their external columns a larger diameter than to the intermediate columns, because, as had been said by Vitruvius, there was a larger amount of air round them than round the intermediate ones: and it had been found, with reference to the excess of the diameter of the external columns in the Parthenon, that it was only one fiftieth of the diameter, so delicate was the perception which the Greeks had of the effects of visual error. When Mr. Penrose propounded his theory, of the horizontal curvature of the base and entablature of the Parthenon, it fell to his (Mr. Bellamy's) lot to combat that opinion; and although he knew the Parthenon was founded upon a rock, and therefore subsidence had no place in that building, yet he believed, looking at the fractional amount of curvature, it was owing to some slight irregularity of the masonry, rather than to any principle which guided the Greeks in introducing an entasis. Intending to be present that evening, he had paid a visit to the Royal Exchange—that great work of Mr. Tite. The stylobata there was broken up, and was not continuous; but there was a continuous entablature, and it was impossible to conceive anything more true or more agreeable to the eye, though it was bounded by right lines and consequently by right planes. If Mr. Tite had introduced there the curves of Greek architecture he (Mr. Bellamy) conceived it would have resulted in deformity. The only similar case in London which occurred to him was in the long line of the Royal Institution, in Albemarle-street, which also was straight. This brought him to the observations of Mr. Scott Russell, in reference to proportion, from whose views he ventured to differ. Let them look along a line of railway laid down as accurately as any right line could be laid, (and they found nothing which would better illustrate the laws of perspective,) and yet they found that the rails came to a point at the end of the range of vision. If Mr. Scott Russell was right in his views, the sides of a long gallery ought to be concave, in order that they might appear in right planes.

Mr. Scott Russell said, if what he had stated was right, all the lines on the level of the eye would appear perfectly straight, being in the plane of the eye. There would be no entasis in elevation at the point in the columns of the Parthenon on a level with the spectator's eye; therefore, Mr. Bellamy and he coincided thus far. But there would be entasis on the portions above and below. In the case of a railway, which he admitted to be a good illustration, if they cut off a certain distance it was perfectly straight, and converged in straight lines. But if they stood between the two rails, that which was convergent one way would, if they turned round, be convergent the other way.

Mr. Bellamy stated that this was, in fact, the looking at two distinct objects at two distinct times.

Mr. Scott Russell added that he thought Mr. Bell erred with regard to the entasis in the obelisk in this respect; that he considered it should originate at the base, whereas it should commence at a point on a level with the eye.

Mr. Bellamy would tender his thanks to Mr. Bell for the services he had rendered to the architectural profession; and the inquiry which had arisen out of Mr. Bell's proposal to erect this obelisk in commemoration of one of the greatest historical events in this country, would be of the utmost value. Mr. Bell had entered, *con amore*, into so many subjects connected with his art, that he had conferred a very great boon on art generally.

Mr. Robert Hunt, F.R.S., said, that passing from the study of the beautiful in form to the practical, he had a few remarks to make. Nothing could be more appropriate to mark the site of the Great Exhibition—one of the most important events of the present age—than an obelisk, such as that proposed by Mr. Bell, of granite, which, as that gentleman had said, would endure for ages. The question, however, arose of the possibility of obtaining a monolith in this country which should rival Cleopatra's Needle in size. Was it possible that any of our granite quarries could produce in one block, free from flaw, a stone 100 feet in length and ten or twelve feet square? Within the last twelve months he had been at some trouble to ascertain if such a stone could be obtained, and although there were many, and some serious, difficulties in the way, he was satisfied that such a stone could, from two if not from three places, be supplied to order. It was necessary that he should explain a few of the difficulties. The condition in which granite was found was not well understood, and many misstatements had been made. It was generally thought that the granite below followed the contour of the hill formed of it; this was not the case. The granite-hills consisted of a group of botryoidal masses. Each boss might be compared to an onion, which had been cut at right angles to its axis, and placed on its base. Here, and so in the granite, there was a series of concentric layers, varying in thickness; these divisions being known to the quarryman as the "bedway." These curved masses of granite were subject to a system of joints, this jointed structure evidently having some curious relation to the magnetic meridian. Now, a mass of granite must be obtained, the curve of which was sufficiently extended to give a straight piece of the required length, which should be between the bedways at least twelve feet thick, and free from joints. His enquiries and examination enabled him to state such a piece of stone could be obtained from the Cheesewring Quarries, near Liskeard, and from the Lemorna Quarries, near Penzance; and one huge boulder appeared to exist on Dartmoor, far exceeding the required size. With regard to the imperishable character of granite, he had only to refer to the upright stones of the Druidic Circles—the holed stones, evidently connected with the fire worship of the ancient Britains, through which the superstitious mother still drew her child, afflicted with rickets,—to the inscribed stones of Gulval and elsewhere—and the Cyclopean masonry of Castle Freryn, which had stood for thousands of years the beat of the Atlantic gales, without any evidence of decay—to prove that an obelisk of granite might endure for countless ages, to tell the story of the triumph of human industry.

Mr. Bellamy would ask Mr. Hunt's opinion whether a monolith 120 feet long and 14 feet on the sides, could be obtained from the Cheeswring granitic formations?

Mr. Hunt was satisfied that a monolith of 90 feet might be obtained in this country, but they must bear in mind the difficulty with regard to the jointed structure of the mass.

Mr. Bellamy said, of course his inquiry had reference to the perfect homogeneity of the mass. In the case of the Nelson monument in Trafalgar-square, Mr. Freeman, a gentleman well-known in connection with quarries, was consulted as to whether he could furnish a monolith 120 feet in length, and 14 feet on the sides. After sending down to Cornwall, Mr. Freeman reported that he could supply it, if they could find the means of bringing it through London and raising it up on end.

The Chairman said they had listened to a most able paper and interesting discussion, and without longer detaining the meeting, he begged to propose a vote of thanks to Mr. Bell for his valuable paper.

The vote of thanks was then passed to Mr. Bell.

The Secretary announced that this was the last Ordinary Meeting of the Session, and that the Annual General Meeting of the Society would, in accordance with the Bye-laws, be held on Wednesday, the 29th June, at 4 p.m.

WOODEN OR IRON SHIPS.

The following letter has been addressed to the editor of the *Times*:—

SIR,—For some time past so much attention has been directed to the large amounts expended in building and maintaining the ships of the navy, that it may not be considered uninteresting to bring forward some of the advantages of substituting iron for wood in the construction of ships for war purposes.

1. Ships built of iron are stronger, more durable, and less costly to keep in repair, than those built of wood.

2. Iron in any quantity, and of the exact scantling required, can be procured on short notice from the manufacturers in this country.

This will save the large outlay in timber and other materials which must now be kept in stock for seasoning, involving constant expenses, and occupying much valuable space in our dockyards.

3. On an emergency, iron vessels may be built at the dockyards or by contract more rapidly than wood vessels, and without the risk of decay which is always incurred by using unseasoned timber.

Iron lower masts and yards and wire standing rigging should also be substituted for wood mast and hemp rigging, as the former have been proved by many years' experience to be more durable and efficient, and at the same time less costly than the latter.

It is true that many parties still make the same objections that were urged 20 or 30 years ago, and say that iron ships are untried. They certainly are comparatively untried for war purposes, but it is well known that iron vessels built more than twenty years ago, after doing very hard service, are still in good order, and that the majority of private shipowners are giving up the building of wood ships and adopting iron.

The Peninsular and Oriental Steam Company abandoned the building of wood vessels many years ago, and the Royal Mail Company would have been much better off had they done so too, as they have lately had to condemn some of their wood vessels only a few years old, and have iron hulls constructed to receive the engines.

This subject becomes of more importance every day. The experiments made with the new form of guns and projectiles have proved that neither iron nor wood vessels as usually constructed, can withstand a broadside, and that to make them really efficient for war purposes they must be cased with thick armour plates, the weight of which is so great that it is practically impossible to apply them to a wood-built ship and at the same time insure the necessary strength, speed, and seagoing qualities.

The Admiralty have so far admitted the truth of this as to order one large iron screw-frigate of 6,000 tons, which, no doubt, will be followed by many more, as it is clear that one such vessel cannot be of much service for naval operations.

From an experience of 30 years in building and managing iron and wood vessels, I feel convinced that if the construction and re-construction (as it is now called) of wood vessels is persevered in, millions of money will be thrown away which might be saved by the immediate adoption of iron; and as no other country can compete with us in the construction of iron vessels, we shall be able, not only to maintain, but to increase the comparative superiority we have hitherto possessed over all other nations in naval warfare.

Requesting the favour of your inserting this letter,

I am, Sir,
Your obedient servant,
JOHN LAIRD.

Birkenhead Ironworks, Birkenhead, May 21.

Home Correspondence.

THE RELATIVE VALUE OF COKE AND COAL IN LOCOMOTIVE ENGINES.

SIR,—I observe in your report of the discussion on Mr. Fothergill's paper, on Thursday last, that my estimate of the addition of nearly one per cent. to the dividends on the original share capital of railways, which might be made by the general substitution of coal for coke at current prices, has been misunderstood. The estimate relates, as I have said, to the original capital only, not to the entire capital, which comprises upwards of 40 per cent. of preference stock and loans. Of course, a saving in working expenses would not directly benefit the holders of preference and loan stock, and it was for this reason that the estimate was framed in terms of the original capital alone.

I may further say, in rejoinder to Mr. Fothergill's statement at the meeting, that he must be in error in stating that the feed-water heating apparatus was not applied to the *Canute* during the first trials. I know it was on the engine during the whole series of his experiments, as well as during mine; indeed, he says in his paper that it was so. Moreover, there were precisely the same facilities for feeding the boiler with hot water at starting (by the common process of blowing back the waste steam into the tender) with one apparatus as with another, though he appears to claim a distinction in this respect in favour of the "modern" contrivance.

I am, &c.,
D. K. CLARK.

11, Adam-st·eet, Adelphi, London,
May 21, 1852.

SIR,—I notice in the discussion of Mr. Fothergill's paper, in the last number of the *Journal*, that exception is taken by Mr. Bethell, Mr. Lowe, and Professor Wilson, to different statements in a report made by me to Mr. Fothergill, December 28th, 1855, and given at length in that gentleman's paper upon the chemical examination of the fuel used by the London and South-Western Railway Company in their locomotives; and as I was not present on the occasion to reply to these gentlemen, who were imputing just blame, if they were right, to Mr. Fothergill, instead of to myself, who made the chemical examination and report, will you therefore kindly grant me space for a few observations upon their remarks?

Mr. Bethell stated that, "with regard to the analyses before them, he confessed he was astonished at them, and he could hardly believe them to be correct." He further goes on to say, "they found it stated in the table before them that 1 lb. of Ramsay's coal evaporated 15 lbs. of water, whereas 1 lb. of coke evaporated only 12 lbs. of water. Again they found it stated that the Merthyr coal, which contained 89 per cent. of carbon and 4 per cent. of hydrogen, or 93 per cent. of heat-giving properties, evaporated only 14lbs. of water per lb. of coal, whilst Ramsay's coal, which contained only 90 per cent. of heat-giving properties, evaporated 15lbs. of water. That," continues Mr. Bethell, "to a theoretical man seemed an absurdity."

Mr. Lowe followed, and said, "he agreed with Mr. Bethell that there were anomalies in the tables before them, which were most perplexing. Some of these anomalies had been already referred to, and in one instance it was evident there was some mistake, viz., in the statement that there was more sulphur in the coke after it had undergone the carbonizing process than in coal itself. As gasmen they knew that when the gas was evolved from the coal a certain amount of lime was wanted to get rid of the sulphur which came out of the coal during the process, and therefore he thought there must be some error in the analyses before them."

Professor Wilson followed after Mr. Lowe, and said

that, although not agreeing with either of the previous speakers as to the parts of the analysis and results they found fault with as being wrong—on the contrary, arguing that they were more probably not wrong—among other things stated that, "if Mr. Bethell would bear in mind the vast difference between the power of hydrogen and the power of carbon to generate heat, he would readily be able to reconcile the difference in the results obtained in the two cases (which he had quoted) which depended on the atomic proportions in which these two substances combined with oxygen." But Professor Wilson at the same time also said that "he could reconcile the difference in the relative quantities of sulphur in coal and coke, for when, as had been stated, it took 1½ tons of coal to make a ton of coke, it was possible that an extra amount of sulphur might exist in the coke, but he could not understand how coal containing 2 per cent. of ash could be converted into coke containing 7 per cent. of ash, when only 1½ parts of coal went to make 1 part of coke."

The very much larger amount of ash in the coke than in the coal from which it was made appears at first sight strange, but it did not escape my attention, as you will see, if you will turn to my report given in Mr. Fothergill's paper, page 461, of last week's *Journal*, wherein I state—"The next peculiarity to be noticed, between the coke and the coal from which it is made, is in the amount of ash being very much higher in the former than in the latter; this is caused by an excess of iron and silica principally, and were it not for the increase of ash there would not be so very much difference in their heating power, &c. I can only account for this increase in these two substances from their being volatilised in the coking ovens, and entering into the crevices of the fuel from which the gases escape."

"It is common to find large quantities of a hair-like substance adhering to the coke, varying in colour from a light-grey to black; this is silica, with a trace of carbon and iron, and which has been in a state of volatilisation till arrested by coming to a cooler part of the coking-oven, where it has condensed, and is found as I have described it."

These quotations from my report show that I was not ignorant of the ash appearing high in the coke, and that it was necessary, in some way, to account for it, and to show that those apparent anomalies, the excess of ash in the coke above what there apparently should be, and also the large amount of sulphur in the same, were the subject of consideration; and I further say, "that my experiments were repeated, and great care was bestowed to verify any results which appeared contrary to what should have been expected, such as the larger amount of ash in coke in comparison to the coal from which it was made; and the larger amount of sulphur in coke than coal, the general belief being that in the coking of coal most of the sulphur is driven off."

In regard to the sulphur, I also state in my report "that although in coking coal there may be a notable loss in the per centage of carbon, hydrogen, oxygen, and nitrogen in the coke, yet the sulphur has not only not decreased, but has actually increased in the per centage. I find in the coking-oven that not more than one-twelfth of the sulphur goes off from the coal, whilst the loss of the other gases is upwards of one-third of the whole."

"But portions of the coke may be found to contain a very much larger quantity of sulphur than I found in the above specimen, and if I had selected a piece from near the top of the column, instead of taking an average of the whole, I should have found much more than I did.

"The pieces of coke delivered to me by your assistant, which he told me he had taken from a quantity from the tender of an engine in going down to Southampton, on the 2nd ultimo, gave on an average 5·62 per cent. of sulphur, and some which I selected myself from the coke heap at the Nine Elms Station gave about 5 per cent."

Now, although I found only one-twelfth of the sulphur to go off from the coal whilst coking it, this would not interfere with Mr. Lowe's view that it is necessary for "gasmen," when making gas, to apply lime to get rid of the sulphur from the gas; for necessarily, by my showing, one-twelfth of the sulphur in the coal would be in the gas, and *should* be removed from it. What, then, is the quantity of sulphur remaining in the coke from which gas has been distilled? for I presume neither Mr. Lowe, nor any one else, will deny that there is sulphur in it? In my opinion this depends on the quantity of sulphur originally in the coal, and, to some extent, on the heat employed in distilling it; but even when high heats are employed in coking coal, I found it as I have stated, and have confirmed my results by repeated experiments.

I can only surmise, from the remarks of Mr. Bethell and Mr. Lowe upon the results deduced from my analysis of the fuel, that they were not aware of the fact that from the ultimate analysis of combustible bodies their relative values as heat-givers, producers, or generators, are calculated, and that many tables of the relative values of fuels have been constructed, based upon such calculations, for many of which tables I would refer them to the Chemical Technology, by Dr. Ronalds and Richardson, Vol i., page 170 et seq., published by Baillière; and before concluding, I would only add that it is quite possible for one coal to have a higher per centage of "heat-giving properties" than another having a lower per centage, and yet be said to evaporate less water than the lower one. The nature of the "heat-giving properties" must be considered; for one thing the combustion of a given weight of hydrogen has been found by experiments of a perfectly undoubted character, indeed, thoroughly established, to give an amount of heat as near as may be 4½ times as great as the same weight of carbon,* and, consequently, if the hydrogen, under certain circumstances, be greater in the coal of the lower per centage of "heat-giving properties" than in the coal with the higher per centage of "heat-giving properties," which it is in the coals referred to by Mr. Bethell, it might give it a comparatively greater power, which it really does, and which is what I have said in my report.

Trusting that I have shown that my experiments, and the conclusions deduced therefrom, contained in my report upon the fuel of the South Western Railway Company, are neither absurd, anomalous, nor can be challenged,

I remain, &c.,

DUGALD CAMPBELL,

Analytical Chemist to the Brompton Hospital, &c.

7, Quality-court, Chancery-lane, W.C.,
May 25th, 1859.

ORIGIN OF THE ELECTRIC TELEGRAPH.

SIR,—In his letter under this head, Mr. MacGregor expresses a hope that a description of a modern railway locomotive may perhaps be found in some ancient Sanscrit manuscript. Not being acquainted with that language I cannot assist him in the search, but if that gentleman will have the kindness to turn to the Eighteenth Book of Homer's Illiad, verse 373, he will find a very fair description of thirty golden locomotive tripods, moving upon wheels by means of an inward spirit, and the last line literally describes old Vulcan as just closing the last rivets.

Mr. MacGregor may also refer to the Second Book of Spenser's Faery Queen, where he will find a splendid description of two of our great modern discoveries.

In the Sixth Canto, the screw steamer, imaginatively brought to a very high perfection, and in the Forty-Sixth, an equally beautiful description of the electric light.

The suggestion of sympathetic dial-plates, or an electric telegraph, by the Abbé Barthelemy, may be found related in one of the papers of Addison's "Spectator."

* The results of experiments by Dulong, Favre, and Silbermann, Grassi, Andrews.

These and many other instances go far to prove the great power of the human mind, that is to say, the power of preconceiving the possibility of accomplishing certain effects only to be discovered in after ages.

I am, &c.,
HENRY W. REVELEY.

Poole, May 21st, 1859.

Proceedings of Institutions.

ASHFORD.—SOUTH EASTERN RAILWAY MECHANICS' INSTITUTION.—The report for the half-year ending March 31st shows that the number of members has risen from 114 to 138, being four more than at the corresponding season of last year. The library has been considerably improved by the addition of a new and commodious bookcase, and 26 volumes added to it during the half-year, 16 of which were presented by S. Smiles, Esq. The number of volumes now in the library is 882. The drawing and mathematical classes, authorised by the members at the last general meeting to be organised, have been more successful than usual, and it is the desire of some members to carry them on all the year. The council have sanctioned the formation of a chess club in connexion with the institution, and allowed it to use the council room for its meetings. The club, which now consists of 18 members, meets every Monday evening, and is remarkably well attended. The lectures have been particularly well attended by the members this season. The half-yearly accounts have been duly audited, and found in a satisfactory condition.

YORKSHIRE UNION.—The following statement has been issued by this Union in reference to their Village Library:—The Itinerating Village Library, which comprises 45 sections, each containing 50 volumes, or a total of 2,250 volumes, was established with the view of encouraging a taste for reading among the inhabitants of small towns and villages, and of providing the means of disseminating useful information and entertainment of a moral character in places where no such means previously existed, and where a difficulty might be experienced in procuring wholesome literature except at a price beyond the means of the great majority of the population. It ought not to require any arguments to show the great advantages of reading, and the importance of promoting a more general resort to such an employment of leisure hours. It is at once the cheapest and most enduring recreation, available almost at all times and under all circumstances, storing the mind with fruitful and pleasant food for the thoughts, and supplying abundant means for real gratification. When once the capability of reading has been acquired, the man whose day has been spent in labour may recruit his exhausted energies by exercising his mental faculties, and at the same time improve his position by informing himself of the laws of nature, and of those principles which most nearly affect his general interests. It is not only a never-failing but an increasing source of the purest delight, opening the eyes as it were to new worlds, and making apparent mysteries subjects of familiar knowledge. The agriculturist, whether farmer or labourer, may learn the processes by which manures stimulate vegetation, the way in which tillage operates to fertilize the earth, the mode by which roots, leaves, and seeds are formed in the plants which he cultivates, and the surest method of promoting the result which he requires. The cottager may learn something in the production of fruit, flowers, and vegetables, and the country have new charms for all, because its beauties will become more intelligible. The manufacturer, whether employer or artisan, may learn the means by which his objects are accomplished, and achieve greater success by comprehending the causes of failure. As a writer in *Chambers' Miscellany* has well observed, "A man should not be satisfied with being merely skilled in his handicraft. He ought to make himself acquainted with the principles of the operations in which he is concerned. If, for instance, he be a dyer, he should not rest contented with knowing what ingredients will produce certain tints, but ascertain why such is the case. This will cause him to study practical chemistry; and in the course of his investigations he may perhaps make some discovery valuable to himself and the public. Independently, however, of any chance of making improvements in his profession, much good is gained by investigations into first principles." The Rev. H. Moseley, in his report on Education, says:—"The workman need not think, however humble be the craft he exercises, or common the form of matter on which he is called upon to labour, that the science is a thing of small account. Nothing is of small account which comes from the hand of the Almighty, or any truth which is a manifestation of the Divine mind. The man who has acquired the knowledge of a law of Nature, holds in his hand one link of a chain which leads up to God, whether it be developed from the rude fragment of a rock, or from a sunbeam—whether found in the organisation of an insect, or in the mechanism of the heavens. It is in the separation of labour from that science or knowledge which is proper to every form of it, that consists the degrading distinction of a class of the community (in the language of the manufacturing districts) as 'hands.' 'Hands!'—Men who take a part all their lives long in manufacturing processes, involving the practical application of great scientific truths, without ever comprehending them—men who have before their eyes continually mechanical combinations, the contrivance of which they never take the pains to inquire into—men, in respect to whom the first step has never been made which all these things would have continued, the first impulse given which these would have carried on—men, who with subjects of thought all around them, and with everything to impel them to the exercise of it, never exercise thought; and so, the obvious means of their education being passed, they remain always 'hands.'" Beyond all this there is the gratification afforded by the perusal of works of Travel; the descriptions of foreign countries and people, with their manners and customs; the history of our own and other nations; the lives of great and good men which serve for example and encouragement; the models of language in the Essays and other productions of celebrated writers; and not the least important the cultivation of the imaginative faculties by the inimitable poetry of Shakspere, Milton, Pope, Cowper, and other English worthies. For the brief interval of leisure, there are numerous volumes of miscellaneous literature in which entertainment and information are happily blended, while the works of Sir Walter Scott and other writers of fiction may convey a moral lesson in the guise of an interesting tale. A much greater advantage would be gained and additional enjoyment experienced by adopting the practice of reading aloud. More is learned from the voice than by the eye, and though some would feel a little difficulty at first, perseverance would soon render it easy, and even preferable to the silent perusal of a book. It would moreover enable the whole of the domestic circle to share in the information or entertainment which the book may afford, prove an additional bond of family union, promote a desire for knowledge in children, and become a real attraction for home, the prospect of which would sweeten the toils of the day. The duties of reading might be shared by all who are capable of it, so that the "Evenings at home" might even to the poorest prove a never failing delight. The contents of the Yorkshire Union Village Library may be thus classified, and every section of fifty volumes contains a fair selection of each, with some little variety:—

Tales, Novels, and light literature	347 vols.
Historical works	313 do.
Biographical works	293 do.

Miscellaneous works	243	vols.
Travels, &c., in various parts of the World	226	do.
Scientific works	127	do.
Descriptive works	115	do.
Poetical works	114	do.
Agriculture, Gardening, and the Vegetable Kingdom	71	do.
The Animal Kingdom	71	do.
The Fine Arts	43	do.
Social and Domestic Economy	39	do.
Essays, &c.	29	do.
Educational works	28	do.
Philosophical works	28	do.
Manufactures and Commerce	19	do.
Lectures, Letters, &c.	16	do.
Classics	14	do.
Sundry works not otherwise classified	114	do.
Total	2,250	

The terms are 1s. per quarter for each member, to be paid in advance, but where a reading-room with periodicals is also provided, special terms may be made to suit the convenience of each locality. The carriage of the boxes each way is paid by the Yorkshire Union, and may be deducted from the total subscriptions. Communications may be addressed to the agent, Mr. Barnett Blake, Mechanics' Institute, Leeds.

MEETINGS FOR THE ENSUING WEEK.

MON. ......British Architects, 8.
TUES. ......Royal Inst., 3. Professor John Morris, "On Geological Science."
Civil Engineers, 8.
WED. ......Geological, 8. Mr. J. Lancaster, "On the Sinking for Coal at the Shireoaks Colliery." 2. Mr. A. Selwyn, "Notes of the Geology of Southern Australia." 3. Mr. James Lemont, "Notes on Spitzbergen."
THURS .....Royal Inst., 3. Mr. Austen H. Layard, "On the Seven Periods of Art."
Antiquaries, 8.
Linnæan, 8. Mr. Bentham, "On *Homalium*." 2. Mr. Bentham, "Synopsis of *Dalbergieæ*."
Chemical, 8.
FRI. ......Archæological Inst., 4.
Royal Inst., 8½. Prof. Huxley, "On the Persistent Types of Animal Life."
SAT.........Actuaries, 3. Anniversary.
Royal Inst., 3. Mr. J. P. Lacaita, "On Modern Italian Literature."

PARLIAMENTARY REPORTS.

SESSIONAL PRINTED PAPERS.

PAR. No.

Delivered on 16th and 18th April, 1859.

27. Schools (Wilts)—Return.
183. Marine Engines—Copy of Report.
203. National Vaccine Board—Copy of Report.
214. Public Income and Expenditure (Year ended 31st March, 1859)—Account.
219. Foreign Shipping—Account.
111. Bills—Offences against the Person.
112. „ Forgery.
113. „ Malicious Injuries.
114. „ Coinage Offences.
115. „ Personation.
116. „ Criminal Writings.
117. „ Larceny.

Delivered on 19th April, 1859.

200. East India (Principality of Dhar)—Return.
215. Common Lodging Houses—Return.
Guano—Correspondence with the Agents of the Peruvian Government.

PATENT LAW AMENDMENT ACT.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.
[*From Gazette, May 20th*, 1859.]

Dated 1st April, 1859.

818. W. E. Newton, 66, Chancery-lane—Imp. in cricket bats. (A com.)

Dated 8th April, 1859.

884. W. E. Newton, 66, Chancery-lane—Imp. in telegraphing and in telegraphic apparatus. (A com.)

Dated 11th April, 1859.

902. W. Boaler, Manchester—Certain imp. in the manufacture of soap. (Partly a com.)

Dated 18th April, 1859.

976. W. E. Gedge, 4, Wellington-street South, Strand—An improved safety apparatus for clearing off condensed steam from steam engines. (A com.)

Dated 19th April, 1859.

984. W. Gosling, 82, Wellington-street, Woolwich, Kent—Improving rifle cannon and projectiles.

Dated 20th April, 1859.

998. J. Apperly and W. Clissold, Dudbridge, Gloucestershire—Improved apparatus for oiling wool.

Dated 26th April, 1859.

1044. W. Mackenzie, Glasgow—An improved method of printing impressions upon an enlarged or reduced scale, either from engraved plates, electrotypes, blocks, drawings, or other surfaces.

Dated 27th April, 1859.

1056. J. Stuart, Musselburgh, Mid-Lothian, and W. Stuart—Imp. in machinery or apparatus for manufacturing nets for fishing, and for other purposes.

Dated 28th April, 1859.

1065. C. Randolph and J. Elder, Glasgow—Imp. in steam engines and boilers.
1067. R. Harrington, 3, Colonnade, Albany-road, Camberwell—Imp. in umbrellas and parasols.
1069. N. J. Holmes, Glasgow—Imp. in electric telegraphs and apparatus connected therewith.
1070. E. Lardenois, Brussels—Imp. in the manufacture of pulp for paper, pasteboard, and other like articles.
1071. T. Clarke, Hackney—Imp. in sheaves or pulleys for paying out and hauling in ropes, chains, and cables, for communicating motion to machinery, and for other useful purposes.
1073. W. A. Tompson, 18, Cecil-street, Strand, and W. Green, Thames Ditton, Surrey—Imp. in apparatus for applying liquids to the throat and air passages for medical purposes.

Dated 29th April, 1859.

1076. W. Corbett, Clayton, near Manchester, and W. Carmont—Certain imp. in the construction and arrangement of furnaces employed in the manufacture of iron and steel, and for other similar purposes.
1077. J. W. Welch, Manchester—Imp. in sizing or dressing yarns or threads for weaving.
1079. E. A. Porteus, 18, Warwick-square, Paternoster-row, and W. H. Burke, 79, Cannon-street, West—Imp. in printing and other presses.
1081. T. Smith, Bredfield, Suffolk—Imp. in cultivating implements.

Dated 30th April, 1859.

1083. J. Toussaint, 1B, Welbeck-street, Cavendish-square—A new process of modelling and moulding for galvano-plastic.
1084. J. Darlington, 36, Cannon-street—Imp. in zinc retort furnaces.
1085. E. Francis, Wrexham, Denbigh—Improved apparatus applicable to the treatment of tea and other useful purposes.
1086. J. Morison, sen., and J. Morison, jun., Paisley—Imp. in looms and in apparatus connected therewith.
1087. W. Clark, 53, Chancery-lane—Imp. in ventilating or supplying air to diving bells and divers, and in holding communicating therewith from above. (A com.)
1089. J. Bull, Port-street, Manchester—Imp. in apparatus used for securing bales of cotton and other substances.
1090. C. H. G. Williams, 39, Regent-square, Gray's-inn-road—Imp. in the manufacture of colouring matters, and in applying the same for dying and printing fabrics and materials.
1091. J. Souquière (called Emile), 29, Boulevart St. Martin, Paris—A new or improved process for distilling coal.

Dated 2nd May, 1859.

1092. T. H. Arrowsmith, Bolton—Imp. in carding engines.
1093. A. Jumelais, Paris—An apparatus yielding illimited power, "so-called French movement."
1094. J. Ferguson, Kilmarnock, Ayr, N. B., and J. Mc Gaveny, Glasgow—Imp. in fasteners for shutters and for similar uses.
1095. W. Bayliss, Wolverhampton—Imp. in the manufacture of iron hurdles and fencing.
1096. R. A. Brooman, 166, Fleet-street—Imp. in, and in connection with, electro-magnetic engines. (A com.)
1097. J. Basford, Brick-yard, Oundle, Northampton—An imp. in the apparatus used when expressing clay or brick earth through dies.
1098. J. Childs, Windsor House, Putney, Surrey—Imp. in the manufacture and useful application of certain alkaline silicates, and in the production of liquor silicis, or liquid flint.
1100. D. Moore, Brooklyn, New York—Imp. in machinery for rubbing or dressing types.
1101. W. Gossage, Widnes, Lancashire—Imp. in the manufacture of caustic soda and carbonate of soda, from certain alkaline liquors and salts.
1102. C. Nuttall, Rochdale—Imp. in machinery or apparatus for grinding wire cards.
1103. F. W. Emerson, 110, Fenchurch-street—Imp. in treating ores to obtain a new metallic substance and its salts, and in the application of such matters, and also certain products of tungsten in dyeing, printing, and painting.

Dated May 3rd, 1859.

1104. A. G. Franklin, 14, South street, Finsbury—Imp. in the manufacture of crayons. (A com.)
1105. W. Johnson, 47, Lincoln's inn-fields—Imp. in the manufacture or production of mineral oil and grease. (A com.)
1107. W. Clark, 53, Chancery lane—Imp. in obtaining or extracting quinine and the principal organic alkalies. (A com.)
1109. W. Sellers, Philadelphia, U.S.—Improved machinery for making screw bolts and nuts.

1112. H. Chapman, Battlebarrow, Appleby, Westmoreland—An improved military camp cooking apparatus.
1113. H. Chapman, Battlebarrow, Appleby, Westmoreland—Imp. in the construction of kettles.
1114. E. W. Scale, Merthyr Tydvil, Glamorganshire—Imp. in railway signals.
1115. R. Mushet, Coleford, Gloucestershire—An imp. in the manufacture of cast steel.

Dated 4th May, 1859.

1116. W. H. Kingston, A.B., Trinity College, Dublin—Improved means of communication between the passengers and guards, and guards and engine drivers of railway trains.
1117. C. F. Vasserot, 45, Essex-street, Strand—An improved form of tuyere for blast furnaces. (A com.)
1118. J. Adolphus, 1, Serle-street, London—An imp. in locks, bolts, and latches.
1119. W. E. Newton, 66, Chancery-lane—Imp. in steam boilers. (A com.)
1120. J. G. Willans, 2, Clarence-place, Belfast—Imp. in utilizing bog stuff or peat, when applied for treating metals and certain mineral and alkaline substances.
1121. J. G. Wilson, 1, Langley-place, Victoria-park, Manchester—Imp. in machinery for cleaning cotton.

Dated 5th May, 1859.

1122. H. Turner, Park-street, Mile-end—Imp. in steam engines and apparatus connected therewith.
1123. J. F. Allender and D. Rowley, Brierley-hill, Staffordshire—Imp. in shears for cutting boiler plates and sheets, and for other like purposes.
1124. J. Scholfield and W. Cudworth, Milnrow, near Rochdale—Certain imp. in machinery or apparatus for spinning cotton and other fibrous materials.
1125. H. Chapman, Battlebarrow, Appleby, Westmoreland—Improved means or appliances for protecting ships against injury from shots, shells, or other warlike projectiles.
1126. H. Chapman, Battlebarrow, Appleby, Westmoreland—Imp. in the construction of fortifications.
1127. W. F. Batho and E. M. Bauer, Salford, near Manchester—Imp. in drills for recessing, cutting slots, keyways, and cotter holes.
1129. W. Clark, 53, Chancery-lane—Imp. in seed depositors or drills. (A com.)
1130. A. Knox, 2, Victoria-cottages, Hertford-road, Kingsland—Imp. in gas regulators.
1131. H. Reynolds, Denmark-hill, Surrey—Imp. in refining sugar and other saccharine substances.
1132. R. A. Brooman, 166, Fleet-street—Imp. in cannon and other fire-arms, and in projectiles, wads, and cartridges to be used therewith. (A com.)
1133. H. Fletcher, 42, Southampton-buildings, Chancery-lane—A machine for scutching and carding tow, oakum, or waste cordage. (A com.)
1134. W. E. Newton, 66, Chancery-lane—An improved steam gauge. (A com.)
1135. W. E. Newton, 66, Chancery-lane—Certain imp. in fish-hooks. (A com.)
1136. J. H. Johnson, 47, Lincoln's-inn-fields—Imp. in pianofortes. (A com.)

Dated 6th May, 1859.

1137. W. Kellingley, 13, Mason-street, New Cross, Surrey—Imp. in the mode of lubricating the journals of the axles of locomotive engines of carriages and machinery.
1138. F. Angerstein, Kennington, R. Clegg, Islington, and G. Thorrington, Egham, Surrey—Imp. in apparatus for obtaining motive-power.
1139. F. W. Hart, Horncastle, Lincolnshire—Imp. in photographic apparatus.
1140. S. Wright, Sudbury—An improved gas governor or regulator.
1141. J. Dixon, Blackburn—Imp. in machinery or apparatus for staining paper.
1143. W. S. Booth, Birmingham—A new or improved washing machine.
1144. J. Frearson, Birmingham—New or improved fastenings for wearing apparel, and for such other purposes as the same are or may be applicable to.
1145. G. T. Bousfield, Loughborough-park, Brixton—Imp. in apparatus for grinding grain and other substances. (A com.)

Dated 7th May, 1859.

1146. J. Combe, 23, Rue du Champ de Mars—An improved plantoforme or apparatus for measuring the hoofs of horses for the purpose of forming their shoes.
1147. J. Bray, Staley Bridge, Chester, and J. W. Harrison, Staley Bridge, Lancaster—Imp. in machinery or apparatus for spinning fibrous materials.
1148. A. C. Bamlett, Middleton Tyas, Yorkshire—Imp. in reaping machines, part of which improvements is applicable to other agricultural implements.
1149. M. Henry, 84, Fleet-street—Imp. in the manufacture and construction of locks and fastenings. (A com.)
1150. R. Mushet, Coleford, Gloucestershire—Imp. in puddling iron and steel.
1151. R. Mushet, Coleford, Gloucestershire—Imp. in the manufacture of iron.
1152. C. Frost, Sun Tavern Fields, St. George's-in-the-East—Imp. in the construction of electric telegraph cables.
1153. R. Pearsall, Smethwick, Staffordshire—Imp. in the manufacture of glass shades.
1154. W. E. Gedge, 4, Wellington-street South, Strand—Imp. in the manufacture of steel. (A com.)
1155. R. D. Kay, Accrington, Lancashire—Imp. in the preparation of certain colouring matters. (A com.)
1156. W. Jeffery, Eastgate-street, Gloucestershire—Rendering more convenient out-door manipulations in photography by means of an improved portable photographic tent and tent camera.

Dated 9th May, 1859.

1157. J. Ramsbottom, Crawshaw Booth, near Rawtenstall, Lancashire—Certain imp. in machinery for printing fabrics.
1159. C. A. H. Marcoux, 71, Rue de Ruisseau, Montmarte, near Paris—A new impelling mover by the pressure of water.
1163. A. Morton, Morton-place, Kilmarnock, Ayr—Imp. in means or apparatus employed in the weaving of figured fabrics.
1165. T. Green, jun., Old Broad-street—Imp. in apparatus applicable to steam boilers, to obtain greater security against explosion.

Dated 10th May, 1859.

1167. Major W. F. Nuthall, North-lodge, Kilburn—Imp. in ordnance and fire-arms, and in projectiles to be used therewith.
1169. W. Wilkinson and C. Whitley, Manchester—Imp. in buttons and fastenings for garments, harness, and other similar purposes, and in the method of securing the same.
1171. J. Norman, Glasgow—Imp. in furnaces.
1173. G. Bell, Wandsworth, Surrey—Imp. in matches or fusees.
1175. W. Keiller, Perth—Imp. in cartridges for guns or small firearms.
1177. J. Absterdam, New York, U.S.—Imp. in impregnating illuminating gas with hydro-carbon vapour.

Dated May 11th, 1859.

1179. A. Manbré, 10, Rathbone-place, Oxford-street—The manufacture of a colouring matter for colouring spirits, beers, vinegar, and other liquids, from sugar produced from rice, maize, carrots, maple, ananas, pompions, chesnuts, mangelwurtzell, sorgho, turnips, and Jerusalem artichokes.

WEEKLY LIST OF PATENTS SEALED.

[*From Gazette, May 20th*, 1859.]

May 21st.

2632. J. Wadsworth.
2635. H. Ellis.
2636. C. Tomlinson.
2637. C. Cuit.
2638. W. Lea.
2640. H. Jordan.
2646. H. Gardiner.
2648. R. Nelson.
2650. S. W. Johnson & J. Varley.
2656. W. Gorman.
2662. R. H. Hughes.
2759. J. Baillie.
2761. M. Henry.
2771. J. Cameron.
2783. M. Henry.
2787. J. Jobson.
2813. M. Henry.
2872. A. V. Newton.
2972. W. Haworth & W. Barker.
2977. T. Pickford.
526. J. Howden.
716. W. Warne, J. A. Fanshawe, J. A. Jaques, and T. Galpin.

Dated 24th May, 1859.

May 24th.

2663. R. A. Brooman.
2668. C. Peterson.
2671. C. E. Amos.
2678. F. H. Maberly.
2680. F. Loos.
2691. J. B. Booth.
2693. P. Griffiths and J. Brennand.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

[*From Gazette, May 20th*, 1859.]

May 16th.

1239. T. Herbert & E. Whitaker.
1291. R. Jobson.

May 17th.

1178. G. Carter.
1194. A. V. Newton.
1297. H. Cartwright.

May 18th.

1180. J. Brown.
1187. W. Maugham.

Dated 24th May, 1859.

May 20th.

1219. J. C. Pearce.
1226. R. Bell.
1315. E. Heywood and T. O. Dixon.

May 21st.

1250. B. Nadault de Buffon.
1267. W. E. Newton.

LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

No. in the Register.	Date of Registration.	Title.	Proprietors' Name.	Address.
4172	May 13.	Improved Levelling Staff	Elliott. Brothers	30, Strand, London, W.C.
4173	„ 13.	Improved Attachment for Box Fastener	Charles Lambert and Son	Fillwood Works, near Bristol.
4174	„ 14.	The Etna Kettle	Edgar Parks	140, Fleet-street, E.C.
4175	„ 17.	An Adjustable Vice	John Walters and Co.	Globe Works, Sheffield.
4176	„ 21.	The Universal Post Advertiser	The Permanent Advertising and General Agency Co., Limited	78, Gracechurch-street, London, E.C.